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Notes on Rosaceae—VI

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ARGENTINA

In an article in Rhodora for January 1909, Prof. M. L. Fernald discussed "The Representatives of *Potentilla Anserina* in Eastern America." The second paragraph of his article reads as follows: "In November, 1908, two extensive monographs of *Potentilla* appeared, but when one turns to these two treatments with the hope of settling his long-standing problems the results are certainly disheartening." And then, "after spending *some days** in the study of the material in the *Gray Herbarium* and the Herbarium of the *New England Botanical Club*," he solves the problems. Fifteen years have now passed since I began my work on *Potentilla* and Dr. Th. Wolf has devoted longer time than that to the study, and neither of us has definitely settled the status of the different forms of this group. When the manuscript of my monograph in the North American Flora went to press I had seen not only the collection in the Gray Herbarium but also those of the New York Botanical Garden, Columbia University, United States National Herbarium, Philadelphia Academy, and the College of Pharmacy, New York. When preparing my original monograph, printed in 1898, I had also seen the collection of the Missouri Botanical Garden. Besides, many of the critical species had been sent to me for determination by the University of California, Mr. T. S. Brandegee, Mr. Parish, and many others.

* Italics are mine.

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In the Gray's New Manual, published September 18, 1908, the authors, Robinson and Fernald, stated under *Potentilla Anserina* as follows: "Var. *grandis* T. & G. is merely a luxuriant state in rich meadows." It is strange that so shortly after, in January, 1909, Professor Fernald should admit this variety as a good species. The difference in the achenes, pointed out by me, evidently persuaded him that it could not be kept in *Potentilla Anserina* L. (*Argentina Anserina* Rydb.). It would have been asking too much if one expected him to admit all at once the eight species recognized in my monograph. My intention is not to defend them as species. The limitation between species and variety will always be arbitrary, so also between variety and form. If Professor Fernald admitted *Argentina argentea* as a variety under the name *Potentilla Anserina* var. *sericea*, he should have admitted *A. occidentalis*, *A. litoralis*, and *A. subarctica* also as varieties. There are certain statements, also, in Fernald's article, to which I must take exception. As Professor Fernald has admitted *Argentina argentea* Rydb. as a variety I should feel content so far as this species is concerned, but I can not pass it altogether. The specimen in the Gray Herbarium from St. John Valley, referred to in Professor Fernald's paper is "in spite of its leaves being silvery on both sides," not *A. argentea*. I remember the specimen very well. Neither is *A. argentea* exactly the same as *Potentilla Anserina sericea* Hayne. Both have leaves silvery on both sides, but in the Rocky Mountain plant the leaflets as a rule are decidedly obovate, with comparatively few ovate teeth, while in the Eurpoean plant the leaflets are usually much longer, elliptic, and with numerous lanceolate teeth directed forward. I have not seen any specimens of *Argentina argentea* east of South Dakota. It needs therefore not to be considered in connection with the flora of eastern North America.

In discussing the species with nongrooved achenes, Professor Fernald criticizes my key, in which I separate *P. pacifica* and *P. occidentalis* from the rest by the petals being "usually over 1 cm. long rounded-obovate," while the others have petals "6–8 mm., rarely 1 cm. long, usually elliptic-obovate." It may be true that I have "never known the full beauty of its large flowers" [*A. litoralis*] and that the given characters do not hold. I did not see the speci-

mens in the herbarium of the New England Botanical Club, although I saw all in the Gray Herbarium. I have never seen any one, however, with such broad rounded petals as are usual in *A. occidentalis*. The latter has usually also broader and more obovate leaflets. Even if *A. occidentalis* and *A. litoralis* should be one species or variety, as you please, and the characters assigned should be found inconstant, the name of the eastern plant should not be *Potentilla pacifica* Howell, for that species was based on *P. Anserina β grandis* T. & G. The type was collected by Scouler and a fair duplicate is in the Torrey Herbarium. If I have not known the eastern plant "in its full beauty," I doubt if Professor Fernald has seen *Potentilla pacifica* in its. At least he did not see it in the Gray Herbarium, for if I remember rightly there was but one fair specimen of it there, shortly before my manuscript went to press.

The first synonym given under *Potentilla pacifica* by Professor Fernald is *P. Anserina groenlandica* Tratt. The type of the latter, collected by Giesecke, I have not seen, but Trattinick's description points evidently to the form of *P. Egedii* Wormskj. with the leaves whitened beneath. Notwithstanding the fact that Dr. Wolf limits *P. Anserina Egedii* to the glabrous form the fact remains that in *Argentina Egedii* (Wormskj.) Rydb. the leaves are whitened beneath or not, even in the same plant. Evidently Dr. Wolf includes in his var. *groenlandica* also the arctic plant from Alaska, which I described as *A. subarctica*. This Professor Fernald reduced to a synonym of *Potentilla pacifica*. Placing the duplicate of the types of *Argentina pacifica*, collected by Scouler, and the type sheet of *A. subarctica* collected by Dr. A. Hollick side by side, few persons would regard them as the same species or at least not as the same variety. *P. subarctica* is characterized by its decidedly turbinate hypanthium and few achenes, characters found only in this species and *Argentina Babcockiana*. In all the others the hypanthium is almost flat. The petals are rarely over 8 mm. long, while in *A. pacifica* they are usually 12–15 mm. long. In the latter the leaves are almost erect while in the other species they are spreading, except when growing among tall grass.

Dr. Wolf's treatment in including all the forms belonging to

this genus in but one species, even if he admits several varieties, is unsatisfactory. He even makes the very distinct *P. anserinoides* a variety of *Potentilla Anserina*. My treatment is not satisfactory to Professor Fernald and to several other North American botanists, being too radical; but Professor Fernald, who has tried a kind of compromise, will not be followed by all. There is no doubt but that he knows the New England species better than anyone else, but the name *Potentilla pacifica* Howell does not belong to the eastern plant, and *Argentina subarctica* is not a synonym of it. If he had treated them as varieties I would have been satisfied, for what he and many others call varieties, I call species.

Argentina Anserina (L.) Rydb. and *A. argentea* are represented by numerous specimens in our herbaria. The others are less well represented. In the herbaria of the New York Botanical Garden and Columbia University are found the following. The lists I had from the U. S. Nat. Herbarium and the Gray Herbarium I have mislaid and can not find.

ARGENTINA PACIFICA (Howell) Rydb.

OREGON: Beach, Nestucca, 1901, *Kirkwood 129;* locality not given, *Scouler.*

WASHINGTON: Chehalis County, 1897, *Lamb 1080.*

BRITISH COLUMBIA: Vancouver Island, *Boas.*

ARGENTINA OCCIDENTALIS Rydb.

CALIFORNIA: Suisun, Solano County, June 6, 1903, *Baker 3217;* Albion, Mendocino County, May 1903, *McMurphy 263;* Mendocino County, May 1898, *H. E. Brown 723;* San Mateo County, May 1877, *H. Edwards;* Pacific Grove, April 1903, *Heller 6632;* Lake Merced, San Mateo County, April 1907, *Heller 8441;* Colima, March 1877, *H. Edwards.*

OREGON: Netarts Bay, June 1894, *F. E. Lloyd.*

WASHINGTON: Granville, July 1902, *Conard 349;* Clallam County, June 1900, *Elmer 2525;* Olga, July 8, 1905, *Engberg.*

BRITISH COLUMBIA: Chase River, Vancouver Island, May 1887, *J. Macoun;* Renfrew, 1901, *Rosendahl & Brand 5;* Queen Charlotte Island, 1901, *Boas 28.*

ALASKA: Yes Bay, June 30, 1895, *Gorman 61½*.

It has been collected also on Behring Island, 1891, *Grebritsky*.

ARGENTINA LITORALIS Rydb.

ST. PIERRE: July 14, 1900, *Arséne*.

NEWFOUNDLAND: Channel, July 27, 1901, *Howe & Lang 785;* Barred Island, 1903, *Sornborger;* Placentia, 1894, *Robinson & Schrenk 42*.

LABRADOR: 1894, *Waghorne;* Nain, 1897, *Sornborger 27*.

NOVA SCOTIA: Mabou, August 1906, *C. B. Robinson 247;* Yarmouth, June 1901, *Howe & Lang 1*.

QUEBEC: Seven Islands, August 1907, *C. B. Robinson 689;* Lake Témiscouata, 1887, *Northrop 117*.

MAINE: Gross Island, Maine Coast, 1893, *Harvey;* Seal Harbor, Aug. 20, 1891, *T. G. White*.

MASSACHUSETTS: West Tisbury, August 1895, *Burgess;* East Medford, June 1878, *Perkins;* Ipswich, *Oakes;* Ipswich, June 1874, *Morong*.

NEW HAMPSHIRE: Sumner Falls, Plainfield, July 1900, *Eggleston 1977*.

RHODE ISLAND: Warwick, *Olney*.

ARGENTINA BABCOCKIANA Rydb.

NEW YORK: Westminster Park, 1910, *Miss E. Babcock;* shores of Oneida Lake June 1896, *Mason*.

ARGENTINA SUBARCTICA Rydb.

NORTH WEST TERRITORY, CANADA: 1861–2, *Onion, Kennicott & Hardisty*.

BRITISH COLUMBIA: Macleod Lake, 1879, *Dawson 7221*.

YUKON: Fort Selkirk, July 18, 1899, *Tarleton 132;* Dawson, July 1899, *R. S. Williams*.

ALASKA: Yukon River near Palisades, July 14, 1903, *Hollick;* Yakutat Bay, 1892, *Funston 34*.

The following are referred here doubtfully:

IDAHO: Sand Point, Aug. 24, 1901, *Umbach 428;* Lake Pend d'Oreille, near Hope, 1892, *Sandberg, MacDougal & Heller 937*.

MONTANA: Midvale, June 1903, *Umbach 217*.

ARGENTINA EGEDII (Wormskj.) Rydb.

HUDSON BAY REGION: Cape Jones, 1899, *A. P. Low 63182.*

LABRADOR: Rama, 1899, *Stecker 368.*

GREENLAND: Disco, 1902, *M. P. Porsild 921;* Kuanersuit *1448;* Fiskernaeset, *Holboell.*

ICELAND: Mura, 1888, *C. Sprague Smith.*

COMARUM

As I have stated in a previous paper, Dr. Wolf erroneously referred *Comarum palustre* L. or *Potentilla palustris* Scop. to the section POTENTILLAE TRICHOCARPAE, subsection NEMATOSTYLAE, series SUFFRUTICULOSAE. The ovaries and carpels are perfectly glabrous and the stem is in no way shrubby, the only perennial part being the horizontal creeping rootstock. Furthermore Dr. Wolf has associated with it *Potentilla Salesoviana* Steph. This is a shrubby plant with hairy ovaries and carpels. The only character that would bring them together is the color of the petals, which are purple or rose colored. In every respect *P. Salesoviana* is more closely related to *Dasiphora* than to *Comarum.* It has the shrubby habit of *Dasiphora*, the pinnate leaves, the scarious, sheathing stipules, the flattened anthers, subcordate at the base and dehiscent on the margins, practically the same arrangement of the stamens, and the woolly achenes of that genus. The only characters in which it does not agree with *Dasiphora* are found in the styles and stigmas and the color of the petals. The style is filiform, not clubshaped, and the stigma acutish and obsolete, not expanded, and bluntly 4-lobed, and the color of the flowers is rose or whitish, not yellow. As the color has no value as a generic character, the characters of the style and stigma are the only characters that would keep it out of *Dasiphora.* It should be included in this genus or else be made a distinct genus. The position of the style is lateral in both *Dasiphora* and *Comarum. Potentilla Salesoviana* differs from *Comarum*, not only in the characters given above, viz., the shrubby habit and the hairy carpels, but also in the form of the anthers and arrangement of the stamens.

The form of *Comarum palustre* common in North America differs considerably from the typical form of northern Europe.

It is usually much taller and the leaflets are linear-oblong, 5–8 cm. long and only 1–2 cm. wide, obtuse or rounded at the apex and with lanceolate teeth. It was described as *Comarum angustifolium* by Rafinesque. In the European form the leaflets are elliptic or oval, mostly acute at both ends, with broad and ovate teeth. This is also the prevailing form in arctic and subarctic America, but the two forms grade in numerous ways into each other, and *C. angustifolium* can be regarded scarcely more than a variety. So also *C. tomentosum* Raf. (*Potentilla palustris villosa* Lehm.). All grades of pubescence occur from a dense and subvelutinous one to practically none.

DUCHESNEA

Dr. Wolf included *Duchesnea indica* (Andrews) Focke in *Potentilla* and associated it with *P. reptans*, *P. canadensis*, etc. With Dr. Wolf's broad view of genera this was very natural, but I can not see how he could keep out *Sibbaldia* and even *Fragaria* from his *Potentilla*. All three have lateral styles, and *Sibbaldia* is even habitually as close to the typical *Potentillae* as *Duchesnea* is.

FRAGARIA

It is exceedingly hard to draw specific lines in this genus. It is easy to distinguish *F. vesca* or *F. americana* from *F. virginiana* or *F. grandiflora*, for in the former two the achenes are wholly superficial, while in the latter two they are set in deep pits in the fleshy receptacle, but such species as *F. californica* and *F. mexicana* connect the two groups, the achenes being in very shallow pits.

A twelve years' study of the genus since the publication of my Monograph of the North American Potentilleae, had not changed my views, and the recognized species remained practically the same in my new revision in the North American Flora, only that three new species were described, two varieties given specific rank, and *F. multicipita* Fernald and the introduced *F. grandiflora* Ehrh. added. The treatment in my monograph was not followed either by the authors of the Gray's New Manual or by those of the New Manual of the Central Rocky Mountains; and I scarcely expected that it would. The former admits only two species and two varieties as growing in the northeastern United States, while

my monograph admitted five species and one variety, and my treatment in the North American Flora admits seven species. *Fragaria canadensis* and *F. Terrae-novae* are both reduced to forms of *F. virginiana*. Concerning *F. canadensis* the following remarks are found: "A form with the pubescence generally more sparing, the hairs on the scape being subappressed, is sometimes distinguished. (*F. canadensis* Michx., in part.)" The first one who in later years took up the name *F. canadensis* Michx. was Dr. N. L. Britton. He was followed by myself. I do not know of anybody else who in print has "distinguished" *F. canadensis* from *F. virginiana*, i. e., pointed out the differences between the two. The plant characterized by us is not a plant with appressed or subappressed pubescence on the scape but one with spreading pubescence. The distinguishing characters given by us are the oblong-conic fruit and the narrower leaflets with shorter petiolules. It is a rare plant and could be a hybrid between *F. virginiana* and *F. americana*, but the well-developed fruit, which is even longer and narrower than in *F. americana*, speaks against it. Besides, Professor Fernald has collected in the lower part of Quebec an entirely different plant, which looks much more like a hybrid between those two species. This plant is intermediate between the two but more like *F. americana* and is apparently sterile, a fact that speaks for a hybrid origin. In the Gray's New Manual the following remark is also found: "Another scarcely separable form has the hairs on both scapes and petioles sparse and subappressed. (*F. terrae-novae* Rydb.)" These characters are true but they are not the only ones. *F. Terrae-novae* has the large flowers of the western *F. platypetala*, the petals being almost twice the length of the sepals, while in *F. virginiana* they are usually about half longer than the sepals. *F. Terrae-novae* is about as distinct from *F. virginiana* as is Fernald's own *F. multicipita*. The difference between *F. Terrae-novae* and *F. multicipita* is that in the former the leaflets are short-petioluled while in the latter they are sessile. The petals of *F. multicipita* are unknown. *F. Grayana* and *F. americana* are regarded as varieties of *F. virginiana* and *F. vesca* respectively. So they were regarded by Dr. S. Watson.

The treatment in the New Manual of the Central Rocky Mountains is rather less satisfactory. *Fragaria bracteata* Heller

is made a synonym of *F. americana*. The two resemble each other much in habit, but in the former the sepals in fruit are ascending or merely spreading, while in the latter they are reflexed as in the European *F. vesca*. It would have been better to reduce *F. americana* to a synonym of *F. vesca*. *Fragaria prolifica*, *F. pumila*, and *F. firma* are given as synonyms under *F. ovalis*. *F. firma* is a pure synonym, for when I described it I had no idea that the strawberry collected by Fendler under the number 206 was the type of *Potentilla ovalis* Lehm. Neither *F. prolifica* nor *F. pumila* are glaucous, but bright green. Professor A. Nelson has placed *F. ovalis*, and consequently also these two species in his division "Leaves somewhat glaucous, pubescence of scape and petioles appressed." He placed *F. platypetala* in the division "Leaves not glaucous; pubescence of the scape spreading or reflexed," although that species usually is decidedly glaucous. *F. glauca* is made a variety of *F. ovalis* although its leaves are by no means "thick." Watson's type has thinner leaves than the type of *F. pauciflora* Rydb., which is regarded as distinct. If *F. glauca* had been made a variety of *F. pauciflora* or vice versa, I would not have made any criticism.

The new species proposed in the North American Flora are *Fragaria insularis*, *F. Suksdorfii*, and *F. yukonensis*. *F. insularis* was based on material from Jamaica, supposed to be *F. vesca* introduced, but the plant is much more glaucous and less hairy than the northern European plant, and the sepals in fruit are not reflexed but ascending or spreading. The plant may be an introduced one in Jamaica, but the same plant has been collected in the Azores and Madeira. It may be the same as the *F. vesca* reported from Spain, but of this I am uncertain as I have seen no Spanish material. Lowe in his flora of Madeira* mentions a wild strawberry with the sepals enclosing the fruit. This may have been *F. insularis*.

In our herbaria are found the following specimens of *F. insularis:*

JAMAICA: Bank, Hardware Gap, 1908, *N. L. Britton 1778* and *3324;* Cinchona ("Wild strawberry"), 1906, *Wm. Harris 9216;* vicinity of Cinchona, 1908, *Alexandrina Taylor 4230* (in part);

* Man. Fl. Madeira 1: 246. 1868.

same locality, 1906, *N. L. Britton 139;* same locality, 1900, *W. N. Clute 228.*

AZORES: Fayal, 1894, *C. S. Brown 77.*

Fragaria Suksdorfii was based on material which I had referred previously to *F. cuneifolia*, but the broadly lanceolate sepals and the decidedly villous fruit distinguish it from that species. The following specimens belong here:

WASHINGTON: Falcon Valley, June 2 and 28, 1883, *Suksdorf 486.*

OREGON: *Wilkes Expedition 440.*

BRITISH COLUMBIA: Meyers Creek, May 5, 1905, *Spreadborough 69948*, is referred here with some doubt, as there is no fruit.

Fragaria yukonensis was described from material originally determined as *F. chiloensis* or *F. glauca*. The type and some other specimens were referred to *F. chiloensis* on account of the thick subcoriaceous leaflets, but the latter lack the fine tomentum mixed with the longer hairs on the lower surface, characteristic of those of *F. chiloensis*. *F. yukonensis* could not be referred to *F. glauca* on account of its thick leaves. In fact it is more closely related to the southern *F. ovalis* which it resembles very closely. It differs, however, in the distinctly petiolulate instead of subsessile leaflets and in the longer bractlets. Besides, *F. yukonensis* is not known outside of the Yukon Territory, and *F. ovalis* not north of Wyoming. The following specimens belong to the former:

YUKON TERRITORY: Lake Lebarge, June 19, 1899, *Tarleton 38;* Rapid City, Aug. 20, 1899, *R. S. Williams;* Ranch Creek, June 8, 1899, *Gorman 1009;* Fifty Miles River, 1899, *A. L. Bolton.*

Fragaria Grayana Vilmorin was restored to specific rank in the North American Flora. It was first described as *F. virginiana illinoensis* A. Gray, under which name it has been best known. It was recognized before Dr. Gray described it, by Price, who recorded it as *F. illinoensis* but gave no description. I have found no specimens in the herbaria from any place east of Indiana and Alabama, although the type was said to have come from western New York. All specimens so named from the eastern states belonged to either *F. virginiana* or *F. grandiflora*, which latter is an escape from cultivation.

Fragaria grandiflora Ehrh., the "pine strawberry," is a native of South America. It is often hard to distinguish it from *F. Grayana*, but the petals are larger, usually over 1 cm. long, the sepals ovate or ovate-lanceolate, the achenes set in shallower pits, and the leaflets thicker. It often resembles closely *F. chiloensis* but lacks the characteristic tomentum of the lower surface of the leaflets. In cultivation are found many crosses between this species and *F. chiloensis* and *F. virginiana*. In the New York Botanical Garden herbarium there are the following specimens of *F. grandiflora*, which were collected far away from dwellings and which were well established at the localities:

NEW YORK: Roadside in woods between Twin Lakes and Mountain Lodge, Adirondack Mountains, July 4, 1906, *Rydberg 7842*.

BRITISH COLUMBIA: Trail, May 19 and June 13, 1902, *J. M. Macoun 63776* and *63777*.

KENTUCKY: Vicinity of Mammoth Cave, May 1899, *Dr. E. Palmer*.

At the same station where the writer collected *F. grandiflora*, he found also the white-fruited *F. vesca*, and the ordinary *F. virginiana*, with a white-fruited form of the latter. The white-fruited *F. vesca* is not uncommon in certain localities from northern New York and Connecticut to West Virginia and eastern Ohio. It is most common in the mountains of Pennsylvania. It is strange that this form should be common and apparently native in a region where the typical *F. vesca* is very rare and is found apparently only as an escape from cultivation. It is questionable if it should not be regarded as a native geographical species even if it originally mutated from *F. vesca*. It is not a form of the native *F. americana*.

The white-fruited form of *F. virginiana* collected in the Adirondacks by the writer and mentioned above, is very interesting. As the white-fruited *F. vesca* and the ordinary red-fruited *F. virginiana* were common along the road and growing together, these white-fruited specimens of *F. virginiana* might be hybrids between the two. They were typical *F. virginiana*, however, in every respect, even to the pitted fruit, except that the latter was white.

SIBBALDIA, SIBBALDIOPSIS, AND DASIPHORA

No essential change has been made in the treatment of these genera since the publication of my monograph of 1898.

DRYMOCALLIS

This genus is exceedingly perplexing as to its numerous and somewhat intergrading forms. It is by no means easy to draw specific lines. As represented in the eastern United States it is easily disposed of, as it is there represented by only one species, *D. agrimonioides* (*Potentilla arguta* Pursh). In the Rocky Mountain region there are at least nine forms which I have regarded as species, and these increase to about two dozen in the Pacific States. In the North American Flora there were admitted in all 28 species. Of these the following were proposed as new: *Drymocallis corymbosa*, *D. foliosa*, *D. pumila*, *D. viscosa*, *D. arizonica*, *D. amplifolia*, *D. oregana*, *D. laxiflora*, *D. albida*, and *D. micropetala*. Besides these, *D. glandulosa monticola* and *D. glandulosa incisa* were raised to specific rank and the name *D. agrimonioides* (Pursh) Rydb. was substituted for *D. arguta* (Pursh) Rydb., as *Geum agrimonioides* both has page priority and was based on the typical form.

Drymocallis corymbosa was described from specimens included in *D. convallaria* in my Flora of Montana. It differs from the original *D. convallaria* in the flat-topped instead of racemiform cyme, the rounded-obovate instead of rhombic-obovate leaflets, and the conspicuously long-hairy stem and petioles.

It is common from Alberta to Colorado, Idaho, Washington, and British Columbia.

Drymocallis foliosa was described from specimens which I had formerly determined doubtfully as *D. glutinosa* Rydb., i. e., *D. valida* (Greene) Piper. It is characterized by its large-leaved inflorescence and its rhombic-obovate coarsely and incisedly toothed leaflets. The following specimens belong to it:

MONTANA: Bridger Mountains, 1896, *Flodman 596*.

WYOMING: Buffalo Fork, 1897, *Tweedy 214;* Encampment, 1901, *Tweedy 4148*.

UTAH: Alta Mountains, 1899, *M. E. Jones 1108*.

Drymocallis pumila was based on some specimens included in *D. rhomboidea* in my monograph of 1898, and some material received later. Although it resembles *D. rhomboidea* in habit, it differs, however, in one essential character, viz., in the styles, which are decidedly fusiform. In *D. rhomboidea* as well as in *D. glabrata* the styles are filiform. Dr. Wolf remarks under *Potentilla rhomboidea* that he has found in "typical and fine specimens" of this species collected by Suksdorf (*no. 742*) the styles to be fusiform. This number of Suksdorf's, as seen below, belongs to *D. pumila* instead. The large flowers would place it near *D. fissa*, but it is a much more delicate plant, the stem leaves are much reduced and the bractlets are elliptic or oval instead of lanceolate or linear. The following specimens belong here:

OREGON: Stein's Mountains, 1901, *Cusick 2571;* same locality, 1901, *Griffiths & Morris 576*, and 1896, *J. B. Leiberg 2508.*

WASHINGTON: Mount Paddo, 1885, *Suksdorf 742.*

NEVADA: Summit Lake, 1901, *Griffiths & Morris 311.*

UTAH: Marysvale, 1894, *M. E. Jones 5375n.*

Drymocallis viscosa resembles much *D. glandulosa* in habit, has the large petals of *D. valida* and *D. fissa* and the bractlets of *D. pumila*, but differs from all in the conspicuous viscidity of the plant. It is known from the type locality only.

Drymocallis arizonica Rydb. resembles closely *D. Hanseni* but differs in the short dense inflorescence and the longer bractlets. It might have been included in that species but it grows in an entirely different region. The following specimens belong to it:

ARIZONA: Mormon Lake, 1898, *MacDougal 64;* Bill Williams Mountains, 1883, *Rusby 137* and *594.*

UTAH: Near St. George, 1877, *Palmer 146.*

Drymocallis amplifolia connects the *D. glandulosa* group with that of *D. Wrangelliana.* It has the habit of the former and the small pale petals of the latter. It is characterized by its large rhombic terminal leaflets, which resemble somewhat those of *D. foliosa.* The latter has very large deep yellow petals. *D. amplifolia* is known from the type station only, from which several specimens have been seen.

Drymocallis oregana was based partly on material included in *D. Wrangelliana* in my monograph and partly on material studied

later. The type was collected by Thomas Nuttall and labeled by him *Potentilla oregana*. This name is cited in Torrey and Gray's Flora as a synonym under *P. glandulosa*. It is, however, more closely related to *D. Wrangelliana*, having the same oval sepals, rounded and mucronulate at the apex, and the small petals of the species; but the pedicels are longer, those of the earlier flowers 1–2 cm. long, the inflorescence less leafy, and the petals pure yellow instead of ochroleucous. The stem is also usually more conspicuously long-hairy. It is of more northern distribution, ranging from the Mackenzie and British Columbia to Idaho and Oregon, while *D. Wrangelliana* is confined to California. The following specimens belong here:

OREGON: Columbia River, *Nuttall;* near Wimer, 1893, *Hammond 114 A;* base of Mt. Hood, 1894, *F. E. Lloyd;* eastern Oregon, 1898, *Cusick 2159;* Juniper Springs, 1896, *Leiberg 2286*.

IDAHO: About Lewiston, May 27, 1896, *A. A. & E. Gertrude Heller 3130;* valley of Big Potlatch River, June 6, 1892, *Sandberg, MacDougal & Heller 316;* Moscow Mountains, May 30, 1900, *Abrams 663*.

WASHINGTON: Olympic Mountains, August 1895, *Piper 2000;* Wenatchee, May 25, 1899, *Whited 1095*.

BRITISH COLUMBIA: Between Kettle and Columbia rivers, July 19, 1902, *J. M. Macoun 34527, 63786,* and *63787;* Skagit Valley, June 23, 1905, *J. M. Macoun 69938;* Chilliwack Lake, 1901, *J. M. Macoun 34440*.

NORTH WEST TERRITORY: *Franklin*.

When preparing the manuscript of my monograph in 1896, I studied several specimens labeled *Potentilla reflexa* Greene. Thinking these specimens authentic I drew my description of *Drymocallis reflexa* (Greene) Rydb. mainly from these specimens. Among this material was *Coville & Funston 1355*, from which the illustration was made. Having the opportunity to see Dr. Greene's type while preparing the new revision for the North American Flora, I saw my mistake, and the plant described as *D. reflexa* in my monograph appears under the name *D. laxiflora* in the later work. In *D. laxiflora*, as well as in most species of the *D. Wrangelliana* group, the leaflets are rounded-obovate and the plant conspicuously viscid; while in Greene's specimens of *D. reflexa*

the leaflets, especially the terminal ones, are rhombic-obovate and the plant scarcely at all viscid. *D. laxiflora* is more closely related to *D. viscida* Parish, but differs in the broader ovate or oval bractlets, the more elongated and slender branches of the inflorescence, and the simple-toothed leaflets.

The following specimens belong to *Drymocallis reflexa:*

CALIFORNIA: Little Green Valley, San Bernardino Mountains, 1904, *R. Hall 7;* Nevada Falls, Yosemite Valley, 1902, *Hall & Babcock 3430.*

For several years there have been in the herbaria of the New York Botanical Garden, of Columbia University, and of the United States National Museum, several specimens resembling in many respects *Drymocallis Wrangelliana* and *D. oregana*, but with minute whitish petals. They could not be included in any of the previously described species. They resemble most closely *D. viscida* Parish, but the petals are white or whitish, not yellow, the plant is less viscid and the bractlets narrower. Besides, *D. viscida* was known only from southern California, and the specimens referred to come from Washington and British Columbia. In the North American Flora these specimens were described under the name *D. albida*. To it belongs the following material:

WASHINGTON: Damp or shady places at Bingen, 1893, *Suksdorf 2209;* Clallam County, June 1900, *Elmer 2526.*

OREGON: Forest Grove, June 3, 1893, *F. E. Lloyd.*

BRITISH COLUMBIA: Chilliwack Valley, July 10, 1901, *J. M. Macoun 34412* and *34441.* Skagit Valley, June 1905, *J. M. Macoun 69939;* Mt. Finlayson, Vancouver Island, June 3, 1887, *John Macoun.*

While collecting in Utah in 1905, the writer discovered another species closely related to the preceding, but differing in the orbicular instead of obovate petals and in the shorter and broader sepals. It was described in the North American Flora under the name *Drymocallis micropetala*. The following specimens belong to it:

UTAH: City Creek Cañon, June 9 and 12, 1905, *Rydberg 6153;* same locality June 9, 1883, *Leonard 105;* Red Rock Cañon, June 11, 1905, *Rydberg 6074.*

When preparing the manuscript for my monograph in 1896, I had not seen any specimens that agreed with Dr. Greene's description of *Potentilla lactea*. As most of the characterization of this species, according to Dr. Greene's own statements, were drawn from a "flower painting," the species was to my mind very doubtful. I have since seen several species from central and southern California which agree very well with Dr. Greene's description. These specimens resemble much in habit my own *Drymocallis gracilis*, but the petals are much smaller, scarcely exceeding the sepals, the plant is smaller and less viscid, and the stem leaves usually reduced. To *Drymocallis lactea* belong:

CALIFORNIA: Meadows above Bear Valley, July 23, 1906, *H. M. Hall 7562;* San Bernardino Mountains, Aug. 1, 1906, *Hall 7613;* vicinity of Hog Ranch, Yosemite National Park, July 1902, *Hall & Babcock 3391;* Griffins, July 1902, *Elmer 3978;* San Jacinto Mountains, July 1901, *Hall 2355;* Sawtooth Peak, 1904, *Hall & Babcock 5686.*

Dr. Wolf's treatment of the species belonging to this genus is altogether unsatisfactory. Of course he includes them in the genus *Potentilla*. *Drymocallis pseudorupestris* is made a variety of the European *Potentilla rupestris*, *D. convallaria* is made a variety of *P. arguta; D. lactea* is only mentioned under *Potentilla rupestris americana; D. rhomboidea* and *D. cuneifolia* are admitted as species; the rest are all bunched under *Potentilla glandulosa*. *D. incisa* and *D. Hanseni* are regarded as mere forms of *P. glandulosa genuina*. *D. fissa* appears under the name *P. glandulosa fissa* Th. Wolf, and *D. ashlandica* is made a mere form of the same. *D. valida* becomes *P. glandulosa glutinosa* and *D. glabrata* is regarded as a form thereof. *D. Wrangelliana* and *D. reflexa* are also regarded as varieties of *Potentilla glandulosa*. This treatment is at variance with the way the plants have been treated in this country, not only by Dr. Greene and myself, who have done the most work on the genera of Potentilleae, but by more conservative botanists. Professor Aven Nelson* regards *D. convallaria*, *D. pseudorupestris*, *D. fissa*, and *D. glutinosa* (= *D. valida*) as good species. These were the only Rocky Mountain species known

* New Manual of Botany of the Central Rocky Mountains.

besides *D. agrimonioides* (= *D. arguta*) and *D. glandulosa* until my revision in the North American Flora. Howell* admits *Potentilla glutinosa*, *P. ciliata* (= *D. ashlandica*), *P. fissa*, *P. glandulosa*, *P. Wrangelliana*, *P. reflexa*, and *P. rhomboidea*. Piper† admits *Drymocallis rhomboidea*, *D. pseudorupestris*, *D. convallaria*, *D. valida*, *D. glandulosa*, *D. glabrata*, and *D. Wrangelliana*. Blankinship‡, who belongs to the conservative school, admits *Potentilla fissa* and *P. rhomboidea* besides those found in my Flora of Montana, viz., *Drymocallis arguta*, *D. convallaria*, *D. pseudorupestris*, *D. glutinosa*, and *D. glandulosa*. Heller§ admits all the species included in my monograph of 1896. Hall || admits *Potentilla lactea* and includes *Drymocallis viscida* Parish under the name *Potentilla glandulosa nevadensis*. Jepson,¶ who is very "conservative," on the contrary admits but one species, viz., *Potentilla glandulosa*. The plant described by him, however, is not *P. glandulosa* Lindley, but *P. Wrangelliana*.

CHAMAERHODOS

The American species of this genus has been regarded as identical with the Siberian *Chamaerhodos erecta* (L.) Bunge. Nuttall, one of America's most acute botanists, was the first to see the difference between the American and the Asiatic plant, and named the former *Chamaerhodos erecta parviflora*. Pickering regarded it as a distinct species, but his name *C. Nuttallii* was not properly published before the appearance of my revision in the North American Flora. In Torrey and Gray's Flora it appears as a synonym. The American plant has usually smaller flowers, the branches of the flat-topped inflorescence are strongly ascending, the pedicels erect or nearly so, and even in fruit scarcely exceeding the flower in length, while in *C. erecta* they are ascending and much longer.

NEW YORK BOTANICAL GARDEN.

* Flora of Northwest America.
† Flora of Washington.
‡ Montana Agricultural College Studies, 1, part 1.
‡ Catalogue of North American Plants, edition 2.
|| Botanical Survey of San Jacinto Mountains.
¶ Flora of Western Middle California.

New species of Uredineae—VIII*

JOSEPH CHARLES ARTHUR

In continuing the monographic work on the rusts for the North American Flora it is found that apparently the following species have not been described. In order to place these species on record and to add such incidental information as may be at hand a brief account of the several forms is here presented.

Puccinia fidelis sp. nov.

O. Pycnia hypophyllous, grouped among the aecia, prominent, large, 112–144μ broad by 65μ high, with compact ostiolar filaments, reaching as much higher.

I. Aecia hypophyllous and caulicolous, scattered over the plant from a diffused mycelium, causing some hypertrophy and etiolation, chiefly on the woody tissues and hence often in rows along the veins, bullate, large, 0.8–1.3 mm. across, dehiscent by irregular slits, overarching epidermis reddish and prominent; peridium wanting; aeciospores globoid, usually 23–26μ; wall nearly or quite colorless, appearing thick, 2–3μ, coarsely verrucose.

II. Uredinia hypophyllous, scattered, round, small, dark cinnamon-brown; urediniospores globoid, usually 23–25μ in diameter; wall cinnamon-brown, rather thin, finely echinulate, pores usually inconspicuous, 2 near the hilum.

III. Telia hypophyllous, scattered, round, small, very pale brownish, cinereous by germination; teliospores oblanceolate or fusiform, 17–19 by 50–67μ, narrowed or obtuse at both ends, upper cell usually shorter and somewhat inverted topshaped; wall nearly or quite colorless, smooth, uniformly thin, 1μ; pedicel short, fragile.

On *Hyptis stellulata* Benth., hills near Guadalajara, Mexico, July 21, 1893, *C. G. Pringle.* The host of this rust was determined at the Gray Herbarium a short time ago. Through the kindness of Mr. A. B. Seymour the very ample original collection was placed at my disposal for study, and all stages of this charac-

* New species of Uredineae—I–VII. Bull. Torrey Club **28**: 661–666. 1901; **29**: 227–231. 1902; **31**: 1–8. 1904; **33**: 27–34. 1906; **33**: 513–522. 1906; **34**: 583–592. 1907; **37**: 569–580. 1910.

teristic species were easily worked out. All the shoots from the perennial roots of the host are invaded and altered by the gametophytic hyphae, showing that the mycelium probably hibernates in the crown of the plant. The sporophytic phase was not so well represented by the collection, and probably has a limited mycelium.

Puccinia exornata sp. nov.

O. Pycnia amphigenous, in small groups, large but sunken in the tissues and not especially conspicuous, 120–160μ in diameter, honey-yellow.

I. Aecia hypophyllous, in small groups surrounding the pycnia, on discolored and unthickened spots, roundish, 0.3–0.5 mm. in diameter, ruptured epidermis overarching, conspicuous; peridium wanting; aeciospores globoid, 24–27 by 26–32μ; wall colorless, 3–5μ thick, coarsely verrucose with closely set oval beads arranged in longitudinal or slightly spiral series.

II. Uredinia hypophyllous, scattered or somewhat grouped, round, 0.1–0.2 mm. across, soon naked, low, pulverulent, pale cinnamon-brown, ruptured epidermis inconspicuous; urediniospores globoid or obovate-ellipsoid, 20–24 by 24–30μ; wall thin, 1–1.5μ, very pale yellow, finely and sparsely echinulate, pores indistinct, apparently 3 and nearly equatorial.

III. Telia hypophyllous, similar to the uredinia but slightly larger and darker in color; teliospores oblong, 19–24 by 37–48μ, round at both ends, somewhat constricted at septum; wall golden yellow, smooth, 1μ thick, slightly thicker above, 2–4μ; pedicel colorless, slender, once to twice the length of spore.

On *Baccharis thesioides* H.B.K., Guatemala City, Dept. of Guatemala, Guatemala, alt. 1465 m., Feb. 2, 1905, *W. A. Kellerman 5368*. The uredinia and telia of this species are very similar to those of *Puccinia oaxacana* Diet. & Holw., but the aecia are wholly unlike, especially in the absence of a peridium and in the coarsely sculptured and thick-walled aeciospores. The host, *Kellerman 4375*, was determined by Mr. J. Donnell Smith.

Puccinia egregia sp. nov.

O. Pycnia hypophyllous, numerous, especially along the veins, preceding the aecia, inconspicuous.

I. Aecia hypophyllous and caulicolous, abundant, scattered over the whole plant from a diffused mycelium, causing etiolation, at first more numerous along the stems and veins, mostly oval,

large, 0.5–1 mm. across, the prominent peridium soon bursting through the swollen reddish base; peridium cylindrical, or flattened laterally, large, 0.3–0.5 mm. in diameter by 0.5–0.8 mm. high, fragile and somewhat evanescent; aeciospores broadly ellipsoid or globoid, 16–21 by 19–26μ; wall colorless, thin, 1.5μ, strongly verrucose with closely set beads.

II. Uredinia not seen; urediniospores mixed with the teliospores, globoid, about 23–27μ in diameter; wall cinnamon-brown, rather thin, 1.5μ, finely echinulate, pores indistinct, apparently 2 and equatorial.

III. Telia hypophyllous, scattered, round, usually small, 0.1–0.2 mm. across, early naked, loosely pulvinate, becoming pulverulent, chestnut-brown; teliospores ellipsoid or obovate-ellipsoid, 21–27 by 35–45μ, rounded or somewhat narrowed at base, obtuse or rounded at apex; wall cinnamon-brown, minutely granular, 1.5μ thick, much thicker at apex by a broad pale umbo, 6–10μ, often appearing vertically striate; pedicel colorless, delicate, short.

On *Baccharis oaxacana* Greenm., Mt. Oaxaca, Mexico, alt. 2850 m., June 23, 1894, *C. G. Pringle*. Through the kindness of Mr. A. B. Seymour, I was enabled to examine the large original collection of this species. The host was determined at the Gray Herbarium in February 1911. The aecial mycelium causes a marked change in the host, turning it pale and giving a drawn appearance. The sporophytic stages appear sparingly on the least changed leaves.

Puccinia sphenica sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia chiefly hypophyllous, scattered, round, very small, light cinnamon-brown, pulverulent, ruptured epidermis noticeable; urediniospores broadly obovoid, 19–23 by 24–30μ; wall tawny or nearly colorless, 1.5μ thick, minutely and rather closely echinulate, pores indistinct, 3 or 4, equatorial.

III. Telia hypophyllous, scattered, small, pulvinate, chestnut-brown, ruptured epidermis inconspicuous; teliospores ellipsoid, 27–32 by 35–45μ, rounded at both ends; wall smooth, chestnut-brown, concolorous, 2.5–4μ thick, thicker above, 4–9μ; pedicel often inserted obliquely, nearly or quite colorless, terete, fragile, about once length of spore.

On *Baccharis sordescens* DC., Cuernavaca, State of Morelos, Mexico, Oct. 29, 1903, *E. W. D. Holway* 5266. From other North

American species of *Puccinia* on *Baccharis* having teliospores smooth, this species is readily separated by the unusually thick walls of the teliospores.

Puccinia pistorica sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia hypophyllous, abundant, scattered, roundish, large, for some time partially covered by the overarching epidermis, light cinnamon-brown; urediniospores globoid or obovate-globoid, 24–32 by 30–39μ; wall pale yellowish, about 2μ thick, sparsely and strongly echinulate, pores very indistinct, probably few and scattered.

III. Telia amphigenous, in compact irregular groups, of varying size from 0.1 to 1 mm. across, chocolate-brown or blackish, usually shining; teliospores linear-oblong or oblong-lanceolate, small, 12–16 by 39–50μ, obtuse or rounded above, narrowed below; wall smooth, chestnut-brown above, much lighter toward the base, 1–1.5μ thick at sides, 6–12μ thick above; pedicel tinted, slender, one-half length of spore or less.

On *Baccharis glomeruliflora* Pers., Mt. Dora, Florida, March 25, 1891, *L. M. Underwood*. This species is distinct from all other species of *Puccinia* on *Baccharis* that the writer has examined, in the compact and glossy teliosori. The spores show no evidence of germination in the specimen examined. The material in hand, for which I am indebted to Prof. E. W. D. Holway, is scanty, however, and a more extended account must await the collection of better material, which should also supply the pycnial and aecial characters. The locality where the collection was made, as I learn from Mr. P. L. Ricker, is near Lake Dora, on the Tampico and Key West railway, and about halfway between the stations of Tavares and Sorrento. The fungus is not inconspicuous, and is likely to be found throughout southern Florida when searched for.

Puccinia pagana sp. nov.

III. Telia amphigenous, scattered, oval, 0.1–0.4 mm. broad by 0.2–0.7 mm. long, tardily naked, cinnamon-brown, somewhat pulverulent, ruptured epidermis falling away from above the sorus; teliospores oval or oblong, 18–23 by 27–35μ, rounded or obtuse both above and below, not constricted at septum; wall cinnamon-brown, 1.5–2μ thick, often slightly thickened above, 3–4μ, sometimes simulating a pale papilla, finely and inconspicuously verru-

cose, more evidently so above; pedicel colorless, slender, fragile, half length of spore or less.

On *Allium reticulatum* Don, Dead Lake, Pikes Peak, Colo., 3500 meters alt., August 20, 1904, *F. E. & E. S. Clements* (Clements, Crypt. Format. Color. *141*). The collection was issued under the name *P. mutabilis*, but differs from that species in the more oval teliospores without constriction, and with distinctly verrucose surface. No urediniospores are present, not even in the teliosori. Whether urediniospores and aeciospores occur in the life cycle, or not, can not be told or even inferred from the material in hand. Even the material of the host is scanty, showing neither flowers nor bulbs, and some doubt must attach to its correct determination. As it has been impossible to match this material with any other known rust, it is recorded here to attract the attention of collectors.

Uromyces aemulus sp. nov.

O. Pycnia very few, punctiform.

I. Aecia amphigenous, rather closely but irregularly arranged in oval groups 0.5–1 mm. long, on pale unthickened spots, cylindrical, margin erose or somewhat lacerate; aeciospores globoid or irregularly ellipsoid, 20–24 by 23–26μ, often angular; wall pale yellow, 1.5–2μ thick, finely verrucose.

II. Uredinia amphigenous, widely scattered, oblong or oval, 0.5–2 mm. long, dehiscent by longitudinal slits, yellow or light cinnamon-brown; urediniospores globoid or broadly ellipsoid, 22–29 by 25–33μ; wall golden yellow, 1.5–2μ thick, inconspicuosly echinulate, pores indistinct, 5–8, scattered.

III. Telia amphigenous, scattered, prominent, usually oblong, 0.8–3 mm. long, at first covered by the gray epidermis, eventually naked, somewhat pulverulent, dark chocolate-brown or blackish; stroma absent; teliospores globoid or obovate-globoid, 18–24 by 24–30μ; wall chestnut-brown, concolorous, 2–2.5μ thick, slightly or not thickened above, 2.5–4μ, smooth; pedicel slender, about once length of spore.

On *Allium brevistylum* S. Wats., Yanceys, Yellowstone National Park, Wyoming, July 17, 1899, *A. & E. Nelson 5920* (type). The host was determined by Dr. P. A. Rydberg, January 1907, from the specimen in the cryptogamic herbarium of the New York Botanical Garden. Sori of all spore forms are fairly well represented in this collection. They bear the customary relation

to one another on the leaves of the host that is usual in autoecious species. The following specimens also belong here: on *A. brevistylum* S. Wats., Big Horn Mts., Wyo., August 1898, *T. A. Williams & D. Griffiths*, III; Ten Sleep Lakes, Big Horn Co., Wyo., July 30, 1901, *Leslie N. Goodding 422*, II & III; Hot Sulphur Springs, Colo., 2340 m. alt., July 24, 1907, *E. Bethel*, II & III; on *A. validum* S. Wats., Pine Forest Mts., Nev., July 1901, *Griffiths & Morris*, II & III (Griff., West Am. Fungi *391*); and intermixed with *Puccinia Blasdalei* D. &. H. on *A. acuminatum* Hook., Farmington Canyon, Davis Co., Utah, June 3, 1904, 1700 m. alt., *A. O. Garrett*, III (Garrett, Fungi Utahenses *83*).

This species is most easily confused with *Uromyces aureus* D. & H., but that species, which is known only from a single collection made in California on *Allium validum* in 1892, has larger spores, entire absence of urediniospores, and a different disposition of aecia and telia on the leaf, the aecia closely surrounding the groups of telia, and both seemingly arising from the same mycelium.

The type collection was first distributed under the name *Uromyces bicolor* E. & E., and other Wyoming specimens under the name *U. aterrimus* D. & H., which is a synonym of the preceding, but that species, generally at lower levels, has strictly subepidermal telia with well developed stromata, and urediniospores with a larger number of especially distinct pores. In its urediniospore it is similar to the European *U. ambiguus* (DC.) Fckl., but that species has permanently covered telia, and obovate teliospores.

The *Allium* species of *Puccinia* are much given to the production of mesospores, in some sori even to the exclusion of the two-celled spores, but these can be distinguished from the present species by morphological characters. The collection distributed in Garett's Fungi Utahenses, *83*, consists of a mixture of *U. aemulus* and *P. Blasdalei* D. & H. The telia are quite readily separated under a hand lens. Those of the *Uromyces* are grayish and inclined to be naked, while those of the *Puccinia* are quite black and closely covered. The mesospores of the latter have a semihyaline, thickened apex and are not globose.

There has been much confusion in determining the American *Allium* rusts. Most collections are not provided with either flowers or bulbs, which are usually needed to name the hosts, but

fortunately the morphological characters derived from the spores, and the geographical range, afford better diagnostic data than the host species. On the plains between the Mississippi River and the foothills of the Rocky Mountains a number of collections of aecia on *Allium* have been made, which may be placed under the name *Aecidium alliicola* Wint., that may or may not belong to *Puccinia Winteriana* Magn., having uredinia and telia on the grass *Phalaris*. From all that is known of their occurrence and structure, the connection seems probable, the *Allium* and *Phalaris* stages having been collected near each other, although no cultures have been made. Considerable study has recently been given to this group of rusts, and as a result the following key is introduced here to assist collectors.

Key to American and European Allium rusts

Teliospores smooth.
- Teliospores two-celled (*Puccinia*), often with mesospores.
  - Teliospores strongly thickened above, 7–10μ.
    - Aecia absent.
      - Urediniospores with 6–8 scattered pores (not in America). *P. Allii.*
    - Aecia present.
      - Urediniospores with 6–8 scattered pores. *P. Blasdalei.*
      - Urediniospores with 3 or 4 equatorial pores (rarely on *Allium*). *P. Asparagi.*
  - Teliospores not or slightly thickened above, 3–5μ.
    - Autoecious, aecia amphigenous.
      - Telial stromata present, sometimes strongly developed.
        - Urediniospores with 8–12 scattered distinct pores. *P. granulispora.*
        - Urediniospores with 7–9 scattered indistinct pores (rare in America). *P. Porri.*
      - Telial stromata absent.
        - Urediniospores with 6–8 scattered distinct pores. *P. mutabilis.*
    - Heteroecious, aecia (on *Allium*) chiefly hypophyllous.
      - Urediniospores (on *Phalaris*) with 4–6 scattered indistinct pores. *P. Winteriana.*
- Teliospores one-celled (*Uromyces*).
  - Telia tardily naked.
    - Urediniospores with 6–8 scattered indistinct pores. *U. aemulus.*
  - Telia permanently covered.
    - Teliospores not thickened above. *U. aureus.*
      - Teliospores somewhat thickened above.

Urediniospores with 7–12 scattered distinct pores.	*U. bicolor.*
Urediniospores with 5–7 scattered indistinct pores (not in America).	*U. ambiguus.*
Teliospores rough.	
Teliospores two-celled (*Puccinia*).	
Teliospores coarsely verrucose (rarely on *Allium*)	*P. Calochorti.*
Teliospores inconspicuously verrucose.	*P. pagana.*
Teliospores one-celled (*Uromyces*).	
Teliospores finely striate (rarely on *Allium*).	*U. primaverilis.*
Teliospores coarsely striate (not in America).	*U. reticulatus.*

Uromyces probus sp. nov.

O. Pycnia not seen.

I. Aecia amphigenous, on the veins in series 1–3 mm. long, short, cupulate, 0.3–0.4 mm. in diameter; peridium erect or spreading, margin erose; aeciospores broadly ellipsoid, 18–21 by 23–26μ; wall colorless, about 1.5μ thick, finely verrucose.

II. Uredinia amphigenous, solitary or in crowded groups 2–8 mm. across, oblong or linear, 0.5–5 mm. long, rather soon naked, light cinnamon-brown; urediniospores broadly ellipsoid, 19–23 by 26–31μ; wall golden yellow, 2–3μ thick, sparsely echinulate with fine short points, pores 5 or 6, scattered.

III. Telia amphigenous, scattered, numerous, oblong or linear, 0.5–4 mm. long, rather tardily naked, chocolate-brown, ruptured epidermis conspicuous; teliospores broadly ellipsoid or obovate-ellipsoid, 16–21 by 23–29μ; wall dark cinnamon-brown, about 1.5μ thick, slightly thicker above, 2–3μ, smooth; pedicel slightly tinted, usually shorter than spore.

On *Olsynium grandiflorum* (Dougl.) Raf. (*Sisyrinchium grandiflorum* Dougl.), Columbia River, Wash., July 1893, *W. N. Suksdorf* (Ellis & Ev. N. Amer. Fungi *3137*). The type collection was distributed under the name *Uromyces Sisyrinchii* Mont., a name established upon the uredinia of *Puccinia Sisyrinchii* Mont., according to Messrs. Hariot and Sydow (cf. Sydow, Monog. Ured. 1: 601). The only other species of *Uromyces* on *Sisyrinchium* known in either North or South America is the heteroecious species occurring in the eastern United States, *U. Houstoniatus*, which differs conspicuously from the western form not only in having its aecia on an unrelated host, but in the characters of the sori and of the urediniospores and teliospores. Beside the type collection another was made by Mr. Suksdorf on May 24, 1894, but otherwise with same data. A specimen of the same rust was collected on

Sisyrinchium sp., Lake Waha, Nez Perces Co., Idaho, June 27, 1896, *A. A. Heller 3331*.

Uromyces major sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia amphigenous, scattered, oval or oblong, 0.3–1 mm. long, cinnamon-brown; urediniospores broadly ellipsoid, 19–23 by 21–26μ; wall light golden yellow, 2–2.5μ thick, strongly and evenly echinulate, pores 4, equatorial.

III. Telia amphigenous, similar to uredinia, blackish brown; teliospores broadly ellipsoid, 19–23 by 23–27μ, usually rounded at both ends; wall chestnut-brown, not concolorous, 2–2.5μ thick, thicker above, 5–9μ; pedicel slightly tinted, 5–7μ in diameter, once to twice length of spore.

On *Muhlenbergia* sp., near City of Mexico, Mex., Oct. 2, 1896, *E. W. D. Holway*. The collection on which this species is founded is meager and the host is not fully determined, but the rust seems so distinct from any other species of *Uromyces* on grasses, that I venture to record it as a form hitherto undescribed. It differs from the only other North American species of *Uromyces* on *Muhlenbergia*, *U. minimus* Davis, in the much larger spores, in the not concolorous and thicker-walled teliospores, and in the very different range.

Uromyces mysticus sp. nov.

O and I. Pycnia and aecia unknown.

II. Uredinia chiefly epiphyllous, scattered, oblong or linear, 0.5–1.2 mm. long, rather early naked, golden brown, ruptured epidermis conspicuous; urediniospores broadly ellipsoid, 24–28 by 27–32μ; wall golden yellow, 2–2.5μ thick, finely and inconspicuously echinulate, pores 8–12, scattered.

III. Telia chiefly hypophyllous, similar to the uredinia, but remaining covered by the epidermis; teliospores angularly obovate, 18–26 by 26–33μ, rounded or angular above, usually somewhat narrowed below; wall chestnut-brown, moderately and uniformly thick, 2–2.5μ, finely and inconspicuously verrucose; pedicel light yellow, one-half to once length of spore.

On *Hordeum jubatum* L., Denver, Colo., Oct. 29, 1910, *E. Bethel* (Barth., N. Amer. Ured. *91*). This species is readily distinguished from *Uromyces Hordei* Tracy, a somewhat common and more widely distributed form, by the finely verrucose teliospores, which are not thickened at the apex, and by other less

pronounced differences. A collection on *H. jubatum* made at Provo, Utah, without date, *S. M. Tracy 712*, is the only other material belonging to this species that I have seen. Although the rust is on a very common and widely distributed host, it seems to be rare or restricted in its distribution. Possibly it has been overlooked by collectors, owing to its being rather inconspicuous. Without examination under the microscope it might readily be mistaken for the common subepidermal *Puccinia* on the same host, which goes under the name *P. rubigo-vera*.

Uromyces agnatus sp. nov.

II. Uredinia chiefly hypophyllous, scattered, often confluent, irregularly roundish, 0.2–0.5 mm. across, early naked, soon aplanate, somewhat waxy, light cinnamon-brown, ruptured epidermis conspicuous; urediniospores broadly ellipsoid, 18–23 by 21–29μ; wall light golden brown, rather thick, 2–2.5μ, sparsely and inconspicuously echinulate, pores usually distinct, 2, opposite and equatorial.

III. Telia chiefly hypophyllous, scattered, roundish, 0.1–0.4 mm. across, at first bullate, soon naked, pulverulent, dark chocolate-brown; teliospores oval, somewhat narrowed above and below, 23–29 by 29–35μ; wall chestnut-brown, 3–4μ, slightly thicker above, 5–7μ, coarsely and inconspicuously verrucose; pedicel colorless, slender, fragile, about length of spore.

On *Jatropha stimulosa* Michx., Dunedin, Fla., Nov. 26, 1901, *S. M. Tracy 7278* (type); Sanibel Island, Fla., May 17, 1901, *S. M. Tracy 7234;* Summerville, S. C., Aug. 13, 1902, *C. L. Shear 1553;* Lake Worth, Fla., July, 1894, *P. H. Rolfs 17;* Jensen, Fla., no date, *P. H. Rolfs 55*. This species has been confused with the wholly distinct Mexican species on *Jatropha*, *Uromyces oaxacanus* D. & H. In Sydow's Monog. Ured. 2: 183, the description under *U. oaxacanus* is chiefly that of the northern species. In Mexico there is still a second distinct species on *Jatropha*, *U. Jatrophae* D. & H.

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Development of the embryo sac and endosperm in some seedless persimmons

WILLIAM L. WOODBURN

(WITH PLATE 16)

Some time ago observations were made on the development of seedless persimmons (*Diospyros virginiana* L.) in the neighborhood of Indiana University. Two or three questions then suggested have been at least partly answered as the result of further investigation. In addition certain facts have been obtained in regard to the development of the embryo sac and endosperm, which may be of sufficient interest to merit publication. After a brief report on the subject in the Proceedings of the Indiana Academy of Science, 1908, other work prevented further studies along that line until this winter.

All the persimmon trees found in the vicinity of Indiana University are strictly dioecious. The pistillate flowers have aborted stamens and the staminate flowers have rudimentary carpels. In none of the former is there a suggestion of the development of pollen. Pollination must then be effected through the agency of insects, particularly bees, which frequent the blossoms in great numbers. Some pistillate trees are as far as three or four miles from any known staminate ones, consequently as large a number as 70 per cent or 80 per cent of the flowers frequently fail to be pollinated. These develop fruits usually of a smaller size but otherwise not of inferior quality. The relative number of seedless berries on an individual tree varies from year to year. Neither is there any special localization of the two kinds except that fewer seeds are found on the lower branches. The fruits developed in the near vicinity of staminate trees are usually quite full of seeds, seldom any being entirely without.

As suggested above, a larger fruit is usually developed from those flowers in which pollination has occurred, but there are many trees on which a large per cent habitually fail to be polli-

nated. The fruits of the latter, however, continue to develop and the integuments of the ovule often enlarge considerably into flat thin seedlike bodies. The structures in the ovules are very hard to procure in proper sections for staining, due to the very hard nature of the integuments. Therefore great care was exercised in arriving at conclusions in regard to the presence or absence and the nature of certain structures in the embryo sac.

The sections for microscopical studies were all made from ovaries that would evidently have formed seedless fruits, as no indications of pollen tubes were evident, and preparations were examined which included the earlier stages in the development of the embryo sac as well as later ones showing the parts nearly or quite degenerate. The considerations then in the following paper must be taken to refer to "seedless persimmons," as none of the material on hand contained evidence of embryonal development, and later observations showed that the trees from which the material was taken bore a very high percentage of seedless fruits.

THE DEVELOPMENT OF THE EMBRYO SAC

Only a small nucellus is formed, PLATE 16, FIG. 13 representing its greatest development but showing no indications of a spore mother-cell or spores. The earliest stage observed in the development of the embryo sac is shown in FIG. 1. Only two nuclei are present and these are near the chalazal end. Whether this condition represents a normal stage or an incomplete development I am unable to say, for many preparations of incompletely developed embryo sacs were found. The growth of the embryo sac takes place well toward the micropylar end of the nucellus, all of this portion eventually breaking down, leaving a small but quite persistent remnant at the opposite extremity. FIG. 2 shows a condition frequently met with. The egg apparatus seems quite normally developed and the polar nuclei are closely associated. The two latter have not been observed in an actual state of fusion although some preparations show the contiguous sides to be somewhat flattened (FIG. 4). Other sections of the same ovule (FIG. 2) show one or two antipodal cells, but frequently these are not of definite form or constant in number. FIG. 3 shows three antipodal cells all present in the same section. Only two cells

of the egg apparatus are shown but the third cell is present in the succeeding section of the series. Traces of the polar nuclei are present, one of which lies in the neighboring section but the other one is apparently disorganizing. No later stage in the fusion of the polar nuclei was observed than that shown in FIG. 4, where they are merely very closely associated. FIG. 5, 6, and 7 represent a condition which seems difficult of explanation and yet is consistent with facts brought out in FIG. 8–11. By following through the successive sections of this ovule (FIG. 5–7) three nuclei were found in the region usually occupied by the egg apparatus. FIG. 5 shows one nucleus lying in a large cell not unlike an egg cell. FIG. 6, which is the succeeding section, contains a nucleus in a denser cytoplasmic mass nearer the periphery of the embryo sac, and the next section shows the third nucleus in a still denser mass at nearly the opposite side of the sac. This latter mass appears to be of a mucilaginous nature, only a portion of it differentiating like the ordinary cytoplasm of the egg apparatus. FIG. 6 and 7 do not appear to represent either egg cell or synergids but resemble more nearly disorganizing nucellar tissue. (Compare FIG. 1 and 4.) However, FIG. 5–7 may merely represent a breaking down egg apparatus consequent to the failure of fertilization. Disorganizing nuclei of the nucellar tissue lie in the peripheral cytoplasm of the embryo sac.

I am convinced that a complete embryo sac is not always organized, and that even in the absence of fertilization, whether completely organized or not, development in the sac does not always cease at this point. FIG. 8 and 9, drawn from the micropylar end of the embryo sac, seem to be a slightly more advanced stage. They represent neighboring sections of the same ovule but two distinct groups of cells. The cells of FIG. 8 more nearly resemble those of the egg apparatus than do those of FIG. 9. A similar condition is shown in another ovule (FIG. 10). Neither evidence of fertilization nor development of the egg were discovered at this or later stages, but nuclei appear around the periphery and somewhat more numerous in the micropylar region of the embryo sac. The entire history of these nuclei has not been traced but their appearance would suggest that they may have originated from the polar nuclei. That they represent an early stage of

endosperm formation is quite clear. (Compare FIG. 10, 11, and 12.) Development proceeds more rapidly in the micropylar portion, which may be for a time separated from the opposite or chalazal region (FIG. 11). The cellular endosperm continues its inward development until the entire cavity is filled. In the region formerly occupied by the egg there are usually remnants of broken down tissue (FIG. 12). Although the sections were all examined carefully, there were no indications of a pollen tube having penetrated, nor of an embryo at least as far as the ovule.

The development of the endosperm in the seedless persimmon agrees with that noted within recent years for a few other plants but not conforming to the generally accepted theory of endosperm development in angiosperms.

Juel ('98) found that the polar nuclei in *Antennaria* come close together but do not fuse. On the contrary they separate and form endosperm at the same time that the egg parthenogenetically develops an embryo.

Coulter ('98), in *Ranunculus multifidus*, found free nuclear formation of endosperm before fertilization. He suggests that the presence of the pollen tube in the pistil may cause this premature formation. Practically the same conditions with no evidence of fertilization were observed by Smith ('98) in *Eichhornia crassipes*.

Overton ('02) discovered along with parthenogenesis in *Thalictrum purpurascens* the endosperm nucleus always dividing before the egg. Johnson ('02) found similar conditions in *Piper medium* and *Heckeria umbellata*.

Coker ('07) observed endosperm development in *Pontederia cordata* and *Heteranthera limosa* taking place in two distinct regions, a smaller antipodal and a larger micropylar. I find that somewhat the same condition may obtain in the seedless persimmon, except that the chalazal portion in the latter is relatively much larger than those figured by Coker for *Pontederia* and *Heteranthera*. The figures of Smith ('08) show a striking similarity to my FIG. 10 and 11.

CONCLUSIONS

That any of these features are constant for the seedless persimmon is not at all certain, on the contrary there seems to be

a great variation. A fully developed embryo sac is not always formed before the parts begin to disorganize. There is a tendency toward incomplete organization especially of the antipodal cells. The egg apparatus is, of all the parts observed, most frequently in a state of complete organization but it too may break up prematurely. The polar nuclei are often observed in close contact but never in a state of fusion. The integuments frequently push in at this stage and obliterate the cavity of the embryo sac without further development of the latter. However, considerable endosperm tissue may be produced while at the same time the cells of the egg apparatus disorganize. This development of endosperm is more rapid in the region of the micropyle and may be separated at first from the tissue in the opposite portion. At first free nuclei are observed scattered in the peripheral layer of cytoplasm, then cell formation begins and gradually extends toward the center until the cavity of the embryo sac is completely filled with a cellular endosperm tissue.

It may be of interest also to note that a very defini e nutritive jacket layer of cells is organized from the inner integument (FIG. 3 and 11), and that, although only a small nucellus is formed (FIG. 13), a relatively large portion of it is quite persistent.

It remains an open question as to the stimulus causing the occasional development of endosperm without fertilization. There is the possibility of the presence of pollen tubes in the upper part of the pistil, or at least outside of the ovule, but developing too late to effect fertilization. Whatever may be the stimulus, a well organized endosperm may develop without the initiation of an embryo.

I hope to procure material this summer from trees developing fertile seeds in order to trace the embryology. Experimental plantings show that a large per cent of the well developed seeds germinate readily.

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Explanation of plate 16

FIG. 1. A two-nucleated embryo sac, upper part of nucellus disorganizing. × 450.

FIG. 2. Egg apparatus and polar nuclei. One or two antipodal cells were present in the next section. × 450.

FIG. 3. Embryo sac showing antipodals. Upper part of nucellus has disappeared. × 450.

FIG. 4. Egg apparatus. Polar nuclei flattened on contiguous sides. × 525.

FIG. 5, 6, and 7 are successive sections of the same ovule. × 150.

FIG. 6 and 7 represent only the micropylar region.

FIGS. 8 and 9 are successive sections through corresponding regions of an older embryo sac, showing two distinct groups of cells. × 150.

FIG. 10. Section of embryo sac showing peripheral endosperm nuclei and a group of disorganizing cells, evidently the egg apparatus. × 55.

FIG. 11. Showing the development of the endosperm in two regions. × 55.

FIG. 12. Endosperm completely filling the embryo sac. × 55.

FIG. 13. Outline sketch showing extent of nucellus surrounded by inner integument, before formation of megaspore.

Teratological fruits of Ptelea

J. Arthur Harris

(with plate 17)

For the most part the literature of plant teratology is composed of purely casual observations, chiefly records of bizarre structures which have caught the attention of the observer who contented himself with describing and theorizing. But the work of Magnus, Masters, Penzig, de Vries, Vöchting, and some others has shown that teratology can be taken up as a problem for serious and continued work, and with profitable results.

Some years ago I became much interested in certain problems involving the frequency and degree of development of plant anomalies commonly classed as teratological. Among the things it is desirable to determine concerning teratological structures through the examination of large series of material are:

Frequency of occurrence.

Range of variability in development.

Continuity or discontinuity in development.

One of the series of material upon which observations were begun in the winter of 1907 I have not found time nor opportunity to continue and the data are put on record here for the benefit of anyone occupied with problems of this kind.

Several observers have described trimerous fruits in *Ptelea trifoliata*, as Roeper,* Schimper,† and Masters.‡ As material for further work I used the numerous fruits of eleven shrubs growing in the North American Tract of the Missouri Botanical Garden. Two objects were in view. First, to gain some rough approximation to the frequency with which anomalous fruits occur. Second, to ascertain whether the limit of variability of the fruit is reached with the typical two-winged and three-winged forms, and especially to find by extensive series of countings whether there is perfect

* Roeper, J. Linnaea **2**: 85. 1827.

† Schimper, C. Flora **12**: 433. 1829.

‡ Masters, M. T. Vegetable Teratology 364. 1869.

discontinuity between di- and trimerous fruits, or whether these two types are connected by transition stages. If transitional conditions are found their relative frequency of occurrence was to be gotten.

Nine classes of fruits were recognized among twenty-nine thousand examined. The distribution of the fruits among these classes is shown in the table.

TABLE OF FREQUENCY

CLASS OF FRUIT	Number of Shrub											Totals
	A	B	C	D	E	F	G	H	I	J	K	
1. One wing only developed	—	—	—	—	—	1	1	—	—	—	1	3
2. Normal 2-winged condition	4,400	1,077	1,797	4,080	2,238	923	3,969	772	3,257	3,865	2,323	28,701
3. Third wing present but less than half developed	4	10	—	4	3	—	4	1	—	10	—	36
4. Third wing incomplete but over half developed	—	—	1	3	—	—	1	1	—	2	—	8
5. Typical 3-winged condition	17	22	2	40	11	—	14	3	15	69	4	197
6. Four wings, but 2 imperfectly developed	—	1	—	—	—	—	—	—	—	—	—	1
7. Four wings, but 1 imperfectly developed	—	—	—	—	—	—	—	—	—	—	—	—
8. Typical 4-winged condition	—	2	—	—	1	—	—	—	—	1	—	4
9. Paired fruits on the same pedicel	—	(1)*	—	—	(1)	—	—	—	—	(1)	—	(3)

* This pair belonged to class 3 and is counted in with the 10 there.

It appears that in the individuals examined the anomalous fruits were rare; those with but a single wing occurred in only one one-hundredth of one per cent of the cases examined; the typical three-winged fruits formed far less than one per cent of the series. No stress is to be laid on these figures, for the percentage of anomalous organs may vary greatly from shrub to shrub; the relative proportion of the different grades of anomaly is of greater interest.

It is quite clear that conditions 3 and 4 are much more rare than either 2 or 5, but even with nearly 29,000 observations the numbers are too small to determine whether transitional stages between trimerous and tetramerous fruits are rare as compared with the perfectly developed condition.

Generally two-winged fruits have two cells while three-winged fruits have three cells. A considerable series of fruits, many of them not included in the table, were sectioned to verify this point. Incidentally the number of seeds developing was noted.

Fruits with two wings and two locules may have 0, 1, or 2 seeds. For frequencies I found:

Seeds	0	1	2	Total
Frequencies	47	412	77	536

Likewise for the three-winged fruits:

Seeds	0	1	2	3	Total
Frequencies	33	159	80	15	287

Of the 287 three-winged fruits, thirteen were possibly bilocular; the remainder were clearly trilocular. Perhaps in these apparently bilocular fruits the partition wall had simply broken down, but two wings may have developed on the backs of some of the carpels.

For the mean number of seeds per locule we have:

Two-winged, $A = 1.056$.
Three-winged, $A = 1.268$.

But I lay no stress on the comparison, both because of the smallness of the number of pods dealt with, and because the two-winged fruits sectioned were not gathered in proportion to the three-winged fruits from each individual tree, but were merely a random sample saved for another purpose. A detailed study of material so collected that the possibility of difference in fecundity of individual trees could not cast doubt on the results, might be profitable.

COLD SPRING HARBOR, N. Y.

Explanation of plate 17

Diagrams of normal and abnormal fruits of *Ptelea*. FIG. 1; class 1. FIG. 2, 3; class 2, *in toto* and in cross section. FIG. 4; class 4. FIG. 5–7; class 5, *in toto* and in cross section. FIG. 8, 10; class 8. FIG. 9, 11; class 9.

Description of two new fossil figs from Wyoming and Montana *

F. H. KNOWLTON

The fossil fruits herein described have been in hand for many years awaiting the completion of a large general work that should deal fully with the floras of certain of the Upper Cretaceous and Lower Tertiary formations of the Rocky Mountain region. As a wealth of new material has yearly continued to pour in from these horizons, the completion of the work has been of necessity delayed, and it may still be some time before it can be finished. In the meantime it seems desirable that some of the more striking or interesting of the new forms should be published in order that they may be made available for the use of other workers in the field. The present paper, which will be followed by others, deals with two remarkable fruits of *Ficus* from Wyoming and Montana.

Ficus Ceratops sp. nov.

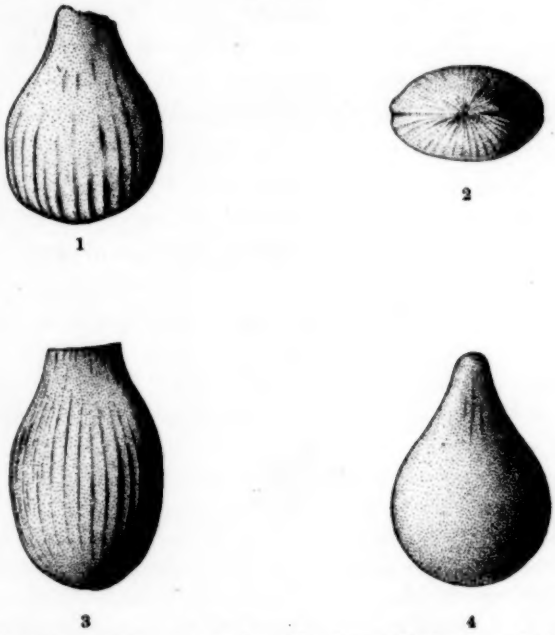
Palmocarpon n. sp. Knowlton, in Stanton and Knowlton, Bull. Geol. Soc. Am. **8**: 136. 1897.

Fruits pearshaped or obovoid in shape, narrowed proximately into a thick neck (usually broken), and globosely expanded distally; walls thick and apparently woody in texture, usually provided with numerous, more or less prominent ribs which converge in the narrowed neck; apex rounded and obtuse or slightly depressed to a small pit or apparent opening into the interior; seeds absent, the interior being filled with coarse sandstone of the matrix. [See FIGURE.]

These remarkable and admirably preserved specimens, of which there are nearly one hundred before me, were collected by the late J. B. Hatcher on June 24, 1881, in Converse County, Wyoming, in beds of the Lance formation, which contained abundant remains of the now well known horned dinosaurs. They were thought by the collector to be the bulbs of some monocotyledonous plant, and this supposed resemblance is by no means far fetched. They were all found within a very small area, and, according to Mr. Hatcher, each one when discovered was resting with the large globular

* Published with the permission of the Director of the U. S. Geological Survey.

end downward, a position that heightened their resemblance to small bulbs, at least to the casual observer. Without careful study they were supposed to be palm fruits, and in the paper above mentioned they are recorded as a new species of *Palmocarpon*. But on careful study it appeared that they failed to meet the requirements for a reference to the palms, and in casting about for possible relationship it was suggested to me by Mr. F. V. Coville,



Ficus Ceratops sp. nov. 1, 3, and 4, side views of fruits; 2, end view of 1.

botanist of the United States Department of Agriculture, that they were probably fruits of a species of *Ficus*, and such they undoubtedly are. In the seed collection of the United States National Herbarium I find (*no. 11,713*) a single woody fruit of a *Ficus*—unfortunately without specific name—from Egypt that is hardly to be distinguished from them. This is of approximately the same size and is of precisely the same shape and appearance as the fossils, having a thick woody "shell" provided with numerous somewhat finer ribs or striae, the main point of difference being in the apex, where the entrance to the interior cavity is much larger and practically closed by a woody diaphragm or protuber-

ance from the interior. In the fossils the presence of this pore is demonstrable, but it must have been much smaller and not provided with anything like a diagram. Curiously enough the fossils show little if any evidence of pressure or distortion, which is probably to be accounted for by the fact that the beds in which they occur are nearly horizontal and exhibit no evidence of having been much disturbed since their deposition. They have what was probably a thick, woody "shell," which in all cases appears to have been broken across the neck or basal portion just above the point of attachment, thus permitting access to the interior cavity. This cavity is now filled with the coarse sandstone of the general matrix, mixed with certain extraneous matter, as bits of vegetation, fragments of shells, etc. In no case was the cavity found to contain seeds, which seems rather remarkable considering the fine state of preservation of the fruit as a whole. It seems probable that when the neck was broken the larger, globose end, being heavier, floated downward and the fruits were filled and covered up in this upright position in which they are found.

It should be mentioned that the approximate size of these fruits is as follows: length 2 to 3.5 cm., diameter of neck usually a little less than 1 cm., and the diameter of the globular portion about 2 cm. While these sizes are much larger than the average living *Ficus* fruit there are a number of well-known species having them even larger, such, for instance, as the Indian *F. punctata* Thunb., *F. callicarpa* Miq., and others.

Fruits of *Ficus* in a fossil state are of unusual occurrence and none, so far as I know, has been described that can be removed from the matrix practically perfect. Thus Heer in 1874 described *Ficus protogaea** from the Atane beds of Greenland, and in the Dakota group Lesquereux has found two fruits which he figures† without specific name. More recently Hollick has described and figured‡ another species as *F. neurocarpa* from the Dakota group of Ellsworth County, Kansas, and Cockerell§ has established a species (*F. Bruesi*) from the Miocene of Florissant, Colorado.

* Fl. Foss. Arc. **3**²: 108. *pl. 30. f. 5–7.* 1874.

† Mon. U. S. Geol. Surv. (Fl. Dak. Gr.) **19**: 85. *pl. 10. f. 7, 8.* 1891.

‡ Bull. Torrey Club **30**: 105. *f. 1.* 1903.

§ Torreya **10**: 223. 1910. [Illust.]

No *Ficus* fruits have been before described from the Laramie or any of the related formations.

It is of course impossible to connect these fruits with leaves of *Ficus* in the same beds, though it is possible they may have belonged to a certain large-leaved species present.

OCCURRENCE: Lance formation ("Ceratops beds"), Lance Creek, Converse County, Wyoming. Collected by J. B. Hatcher, June 1881. Types in United States National Museum. Also found in the Lance formation ("Hell Creek beds") on Hell Creek, Montana, by Barnum Brown of the American Museum of Natural History, in which institution these specimens now are.

Ficus Russelli sp. nov.

Fruits similar to the preceding but in general much larger, with coarser, more prominent ribs.

It is perhaps doubtful if this should be considered as specifically distinct from the last. In manner of preservation and general appearance they are identical, but the largest example from Converse County scarcely reaches the size of the smallest specimen under consideration. Thus one of the smallest examples is about 3 cm. long and has a diameter of fully 2.5 cm., while the largest somewhat exceed a length of 4 cm. and a diameter of 3 cm. The pit or depression at the apex showing the point of entrance into the interior is perhaps more prominent and seemingly larger, but it must be confessed the differences are not great.

The material upon which this species is based, numbering between thirty and fifty very perfectly preserved specimens, was collected by Prof. I. C. Russell near Forsyth, Montana. The matrix is a shattered, calcareous sandstone and the fruits are imbedded at irregular distances and in all positions, and yet none is distorted in the least. Associated with the fruits are numerous fragmentary shells belonging to five or six species; and a few fragments of leaves were found in the same beds but unfortunately they are not determinable.

OCCURRENCE: Lance formation ("Ceratops beds"), Forsyth, Montana. Collected by I. C. Russell. Types in the United States National Museum.

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INDEX TO AMERICAN BOTANICAL LITERATURE

(1909–1911)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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